2014

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Reid, C.

Reid, C. (2014) 'The impacts of tuna fisheries on the pelagic ecosystem in the central west Pacific Ocean [POSTER]', The Plymouth Student Scientist, 7(1), p. 216.
http://hdl.handle.net/10026.1/14060

The Plymouth Student Scientist
University of Plymouth

The Impacts of Tuna Fisheries on the Pelagic Ecosystem in the Central West Pacific Ocean

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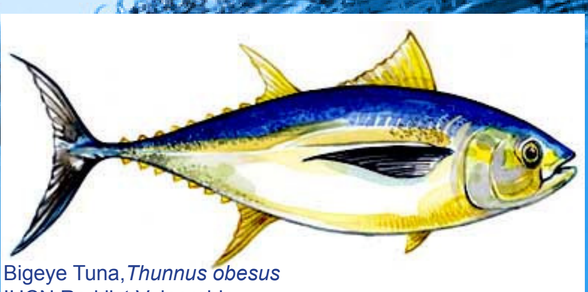
There have been estimates of 23 distinct ecosystems in the marine realm [1].The marine pelagic ecosystem, if considered in its entirety has the greatest size of all ecosystems on earth [2]. It is essential to consider the many different factors that contribute to the vulnerability of this ecosystem, to effectively manage and mitigate against detrimental impacts human activities such as, tuna fisheries may have.



Bigeye Tuna, *Thunnus obesus*
IUCN Red list:Vulnerable

Southern bluefin tuna, *Thunnus maccoyii*
IUCN Red list: Critically Endangered

Yellowfin tuna, *Thunnus albacares*
IUCN Red list: Near-Threatened

Albacore tuna, *Thunnus alalunga*
IUCN Red List: Near-Threatened

The Pelagic Ecosystem encompasses many different habitats; this large and diverse environment has previously been considered to be resilient to externally forced changes such as fishing. In the pelagic ecosystem living resources are exploited through fishing for financial gain, rapidly leading to alteration in resource availability, food-web structure and ultimately to over exploitation. The region of the Central West Pacific Ocean (CWPO) extends to subtropical and temperate regions, making the tuna (Tribe *Thunnini*) [3] within this area a useful indicator species for large scale pelagic migrations. Increased fishing effort has led to increased catch, despite boat numbers showing an overall decline (Fig.3).

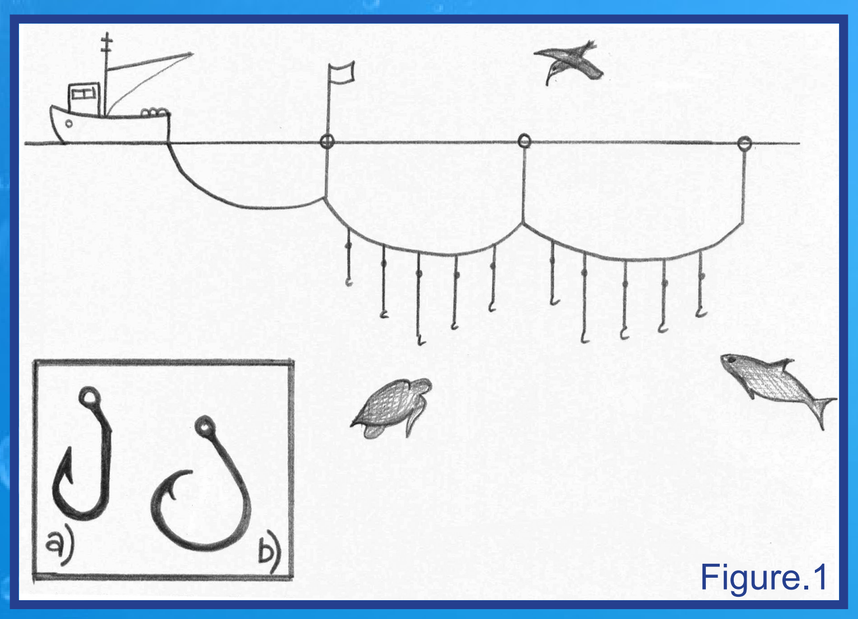


Figure.1

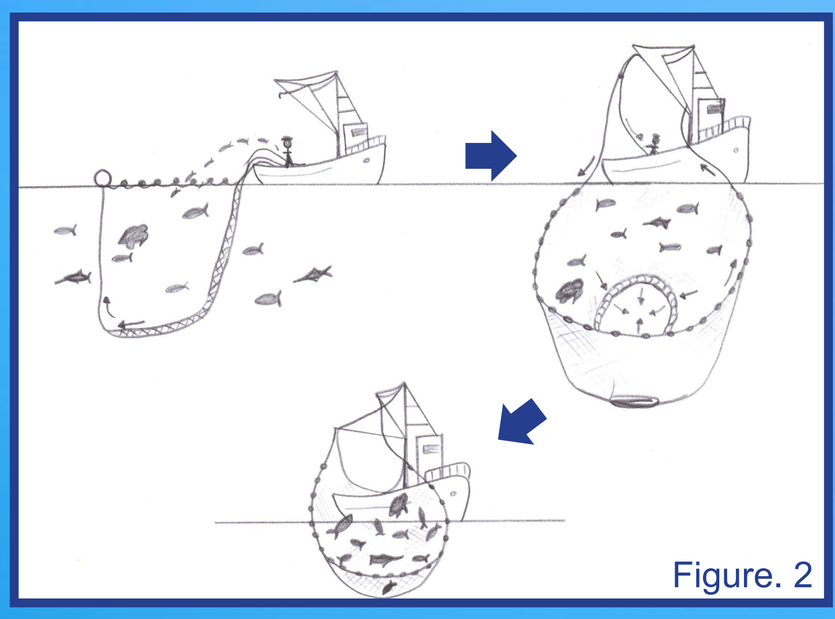
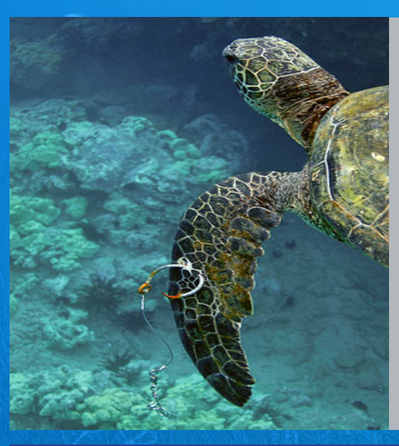


Figure. 2

Fishing techniques

Pelagic long lining is a commercial fishing technique that ranges in scale from domestic artisanal fisheries to modern, industrialized fishing vessels, the lines with baited hooks are set and left for a period of up to 24hrs (Fig.1). Perhaps the most indiscriminate fishing method is Purse Seine netting which is an active fishing method (Fig.2).
The introduction of round hooks in recent years has reduced the turtle catch significantly [4] (Fig1,b).



Bycatch is the portion of the catch that is not the primary target of the fishing effort [5] and is of real concern in the pelagic realm due to the diversity of the organisms affected [6,7,1] .This catch may include undersized (i.e. juveniles) or otherwise unwanted individuals of the target species (size selection for market), juveniles and adults of non-target species, as well as seabirds, marine mammals and turtles [6,7,8].This 'catch' also includes non-target species such as sharks and large fish (Whale sharks), which are retained and sold as 'incidental catch' along with the boats target species landings[8]. Two notable species are the whale shark (*Rhincodon typus*) and oceanic white tips (*Carcharhinus longimanus*). Whale sharks command a high price on the Japanese market, making this species vulnerable to commercial fishing. Due to their K-selected life history, (relatively low numbers of offspring, slow maturation and long life spans) every whale shark caught is of concern, yet an estimated 75 whale sharks were killed in the WCPO region's purse seine fishery in 2009 and 2010.

Conclusions

Increased fishing has resulted in lower trophic levels being targeted in order to sustain the industry. Removal of large apex predators such as tuna has been shown to cause trophic gaps leading to habitat diversity being adversely affected. The regulation of fisheries must be monitored in order to improve sustainability and mitigate against the deleterious impacts that fisheries may have. Lack of consistency in reporting of bycatch makes it difficult to ascertain the effect this undisclosed figure may have on the ecosystem, but scientists agree that this 'incidental' catch is leading to over fishing. The governance of the seas and effective management of fisheries and habitat conservation have in recent years become more transparent, but illegal, unreported and unregulated tuna fishing continues to hamper governance efforts.

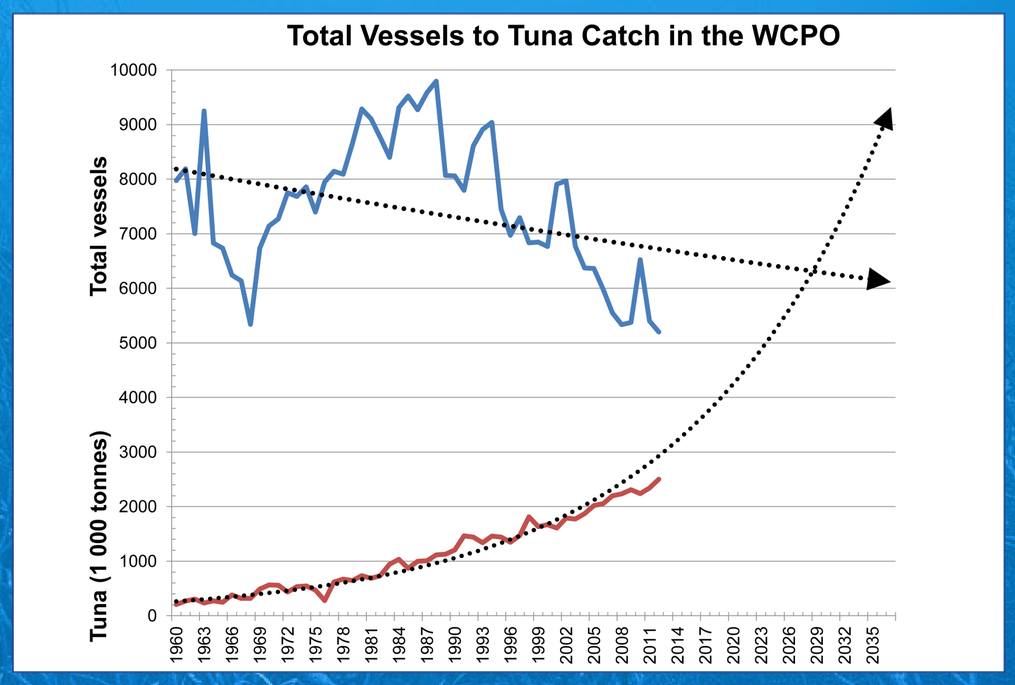


Figure 3. The number of boats registered to fish in the CWPO has declined , yet the overall catch of tuna has increased dramatically [5], with greater technology, larger boats and more days at sea, the tuna are literally being fished to extinction

[1] Halpern et al.,(2007) 'Evaluating and Ranking the Vulnerability of Global Marine Ecosystems to Anthropogenic Threats'. Conserv Biol, 21 (5), **[2]** Gilman, E. (2011) 'Bycatch governance and best practice mitigation technology in global tuna fisheries'. Mar. Policy, 35 (5), **[3]** Starks, E. (1910) 'The osteology and mutal relationships of the fishes belonging to the fammily Scombridae'. Journal of Morphology, **[4]** Nishemura, W. & Nakahigashi, S. (1990) 'Incidental capture of sea turtles by Japanese research and training vessels: results of a questionnaire'. Marine Turtle Newsletter, (51), **[5]** FAO (1994) 'A global assessment of fisheries bycatch and discards'. FAO Fisheries Technical Paper, **[6]** Verity, P., Smetacek, V. & Smayda, T. (2002) 'Status, trends and the future of the marine pelagic ecosystem'. Environ Conserv, 29 (2), **[7]** Gilman et al.,(2012) 'Hawaii longline tuna fishery temporal trends in standardized catch rates'. Aquat. Conserv.: Mar. Freshwat. Ecosyst 22 (4), **[8]** Wassenberg, T. & Hill, B. (1989) 'The effect of trawling and subsequent handling on the survival rates of the bycatch'. Fish Res, 7 .